# Understanding the Social Impact of Digital Platforms: A Student Analysis Based on Recent Research

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## 1. Abstract

**Background:**

Type 2 diabetes mellitus (T2DM) is a major public health problem in India, with a rising prevalence and a high burden of microvascular and macrovascular complications. Poor medication adherence is one of the key reasons for inadequate glycaemic control and long-term complications, especially in resource-limited settings. Clinical pharmacists can play a crucial role in counselling, regimen simplification, and identifying drug-related problems.

**Objectives:**

To assess the effect of a structured clinical pharmacist-led intervention on (1) medication adherence and (2) glycaemic control (HbA1c) among patients with T2DM attending a tertiary care hospital.

**Methods:**

This prospective, interventional, single-centre study will be conducted in the Department of Medicine/Endocrinology of a tertiary care teaching hospital in India. Adult patients (≥ 18 years) with T2DM for ≥ 1 year, on anti-diabetic medication for ≥ 6 months, and HbA1c ≥ 7% will be enrolled. Baseline data will include demographics, clinical profile, current therapy, and medication adherence assessed using the 8-item Morisky Medication Adherence Scale (MMAS-8). All participants will receive a structured clinical pharmacist-led intervention comprising individual counselling, a patient information leaflet, a personalised dose-timing chart, and telephonic reinforcement. Primary outcomes will be change in adherence score and change in HbA1c at 3 and 6 months. Secondary outcomes will include changes in fasting and post-prandial blood glucose, blood pressure and lipid parameters, self-reported hypoglycaemia, and the number and type of drug-related problems identified and resolved.

**Expected Results:**

We anticipate a significant improvement in mean adherence scores and a modest but clinically meaningful reduction in HbA1c (approximately 0.5–1.0%) after 6 months of pharmacist intervention, along with improved patient understanding of diabetes, fewer drug-related problems, and better self-care practices.

**Conclusion:**

A structured clinical pharmacist-driven intervention may significantly improve medication adherence and glycaemic control among T2DM patients. Integration of clinical pharmacists into multidisciplinary diabetes care teams should be encouraged, particularly in tertiary care and teaching hospitals in India.

**Keywords:** Type 2 diabetes mellitus, clinical pharmacist, medication adherence, HbA1c, pharmaceutical care, India

## 2. Introduction

Type 2 diabetes mellitus (T2DM) is one of the most common chronic non-communicable diseases worldwide and a leading contributor to morbidity, mortality, and healthcare costs. India, often referred to as the "diabetes capital of the world", has seen a rapid increase in the number of people living with T2DM over the past few decades. Urbanisation, sedentary lifestyles, unhealthy dietary patterns, and population ageing have all contributed to the growing epidemic. Poorly controlled T2DM is associated with a wide range of complications, including retinopathy, nephropathy, neuropathy, cardiovascular disease, and peripheral vascular disease, which substantially reduce quality of life and life expectancy.

Glycaemic control, commonly assessed using glycated haemoglobin (HbA1c), is central to the management of T2DM. Large clinical trials have demonstrated that maintaining HbA1c close to target reduces the risk of microvascular complications and, to some extent, macrovascular outcomes. However, in routine clinical practice, a substantial proportion of patients fail to achieve recommended HbA1c targets. The reasons are multifactorial and include clinical inertia, limited access to care, socioeconomic constraints, complex regimens, and, very importantly, poor medication adherence.

Medication adherence—the extent to which a person's medication-taking behaviour corresponds with agreed recommendations from a healthcare provider—is a crucial determinant of treatment success in chronic diseases like T2DM. Non-adherence may be intentional (for example due to perceived side effects or lack of belief in the need for therapy) or unintentional (such as forgetfulness, confusion about the regimen, or financial constraints). In T2DM, poor adherence has been associated with higher HbA1c values, increased frequency of hospitalisation, higher risk of complications, and increased healthcare costs. Improving adherence is therefore a practical and cost-effective way to optimise disease outcomes without necessarily adding new or more expensive drugs.

In many Indian healthcare settings, physicians are overburdened, consultation times are short, and there is limited opportunity for detailed counselling. Nurses and paramedical staff often focus on immediate clinical tasks, leaving a gap in ongoing, structured patient education and follow-up. This is where clinical pharmacists can play a vital role. Clinical pharmacy is a health science discipline in which pharmacists provide patient-centred care that optimises medication therapy and promotes health, wellness, and disease prevention. Typical activities include reviewing prescriptions for appropriateness, identifying and resolving drug-related problems, educating patients about their medications, and collaborating with physicians and other healthcare professionals. The role of clinical pharmacists in chronic disease management, including T2DM, has been increasingly recognised in high-income countries, where pharmacist-led interventions have improved adherence, blood pressure control, lipid levels, and glycaemic control in various settings. In the Indian context, clinical pharmacy services are still evolving. While hospital and community pharmacists are traditionally involved in dispensing, stock management, and supply, their potential contributions in direct patient care—especially in tertiary care teaching hospitals—are often underutilised. There is a growing need to generate local evidence on the impact of pharmacist-led interventions in chronic diseases, tailored to the Indian healthcare environment.

In T2DM, clinical pharmacists can support patients in many ways: simplifying complex regimens where possible, explaining the purpose and correct use of each medicine, emphasising the consequences of non-adherence, providing written medication schedules, reinforcing lifestyle advice, monitoring for adverse drug

reactions, and liaising with prescribers when therapy changes are required. Such structured interventions may be particularly useful for patients with poor glycaemic control despite being on appropriate pharmacotherapy. Against this background, the present study proposes to evaluate the role of clinical pharmacists in improving medication adherence and glycaemic control among patients with T2DM attending a tertiary care teaching hospital in India. By using a prospective interventional design, applying a validated adherence scale, and systematically recording laboratory parameters and drug-related problems, this study aims to generate practical evidence that may support the routine integration of clinical pharmacists into diabetes care teams.

**Rationale and Objectives**

Although several international studies suggest that pharmacist-led interventions can improve diabetes outcomes, there is limited Indian data, particularly from government or teaching hospitals where patient loads are high and resources are constrained. Demonstrating benefits in such a real-world environment could encourage administrators and policymakers to formally recognise and expand clinical pharmacy services.

Therefore, this study has been designed with the following objectives:

1. To assess baseline medication adherence among T2DM patients in a tertiary care hospital.
2. To evaluate the impact of a clinical pharmacist-led intervention on medication adherence.
3. To evaluate the impact of the intervention on glycaemic control (HbA1c).
4. To identify and document common drug-related problems in T2DM therapy.

## 3. Materials and Methods

### 3.1 Study Design

This study will be conducted as a prospective, interventional, single-arm study with a pre–post design. All enrolled patients will serve as their own controls. Baseline data on adherence and glycaemic control will be collected, followed by a structured clinical pharmacist-led intervention, and then follow-up assessments at 3 and 6 months.

### 3.2 Study Setting

The study will be carried out in the outpatient clinics of the Department of Medicine/Endocrinology/Diabetology of a tertiary care teaching hospital in [City, State], India. The hospital caters to a large urban and semi-urban population and has existing clinical pharmacy services within the hospital pharmacy and wards. The clinical pharmacy team consists of qualified pharmacists and postgraduate pharmacy students working under the supervision of a clinical pharmacist or faculty member.

### 3.3 Study Duration

The total study duration will be 12 months, broken down as follows:

- 3 months for patient enrolment and baseline assessment
- 6 months for the intervention and follow-up visits
- 3 months for data entry, statistical analysis, and preparation of the dissertation/manuscript

### 3.4 Study Population

**Inclusion criteria**

- Adults aged 18 years and above
- Diagnosed with type 2 diabetes mellitus for at least one year
- On anti-diabetic pharmacotherapy (oral hypoglycaemic agents and/or insulin) for at least six months

- Baseline HbA1c ≥ 7%
- Able and willing to provide written informed consent and participate in follow-up visits

**Exclusion criteria**

- Type 1 diabetes mellitus or gestational diabetes
- Severe psychiatric illness, cognitive impairment, or any condition compromising the ability to participate
- Critically ill or requiring intensive care at the time of recruitment
- Patients currently enrolled in another interventional clinical trial

**3.5 Sample Size**

For an undergraduate project, a pragmatic sample size of 120 patients will be targeted, anticipating approximately 15–20% loss to follow-up. Thus, it is expected that data from around 100 patients will be available for final analysis. This sample size is considered adequate to detect a moderate change in adherence scores and HbA1c over time and to describe patterns of drug-related problems in this setting.

**3.6 Data Collection Tools**

1. **Case Record Form (CRF)**

   A structured CRF will be developed to record:

   - Demographic data: age, sex, educational status, occupation, socio-economic status, residence
   - Clinical data: duration of T2DM, family history, comorbidities (e.g. hypertension, dyslipidaemia, coronary artery disease), smoking and alcohol use
   - Medication details: list of anti-diabetic drugs, doses, frequency, duration, other concomitant medications
   - Laboratory parameters: fasting blood sugar (FBS), post-prandial blood sugar (PPBS), HbA1c, lipid profile, serum creatinine, and other relevant tests as available
   - Anthropometric measurements: height, weight, body mass index (BMI), blood pressure

2. **Medication Adherence Scale**

   The 8-item Morisky Medication Adherence Scale (MMAS-8) or a similar validated tool will be used to measure adherence. Each participant will be interviewed at baseline, 3 months, and 6 months. Scores will be categorised as:

   - High adherence
   - Medium adherence
   - Low adherence

3. **Pharmacist Intervention Record Sheet**

   A separate form will document:

   - Type and content of counselling delivered
   - Educational materials provided (leaflets, charts)
   - Identified drug-related problems (DRPs)
   - Recommended interventions and whether they were accepted by the treating physician

4. **Patient Knowledge Questionnaire (optional)**

   A simple 8–10 item questionnaire will be used to assess basic knowledge about diabetes, medications, and self-care at baseline and at 6 months.

**3.7 Clinical Pharmacist Intervention**

At **baseline**, after enrolment and initial assessments, the clinical pharmacist will:

- Review the patient's prescription for:
  - Potential drug–drug interactions
  - Inappropriate dosing or frequency
  - Therapeutic duplication
  - Medications that may increase risk of hypoglycaemia or other adverse events
- Identify potential adherence barriers, such as:
  - Cost of medication
  - Complex regimens (multiple daily dosing, many tablets)
  - Poor understanding of indications and side effects
  - Fear of injections (for insulin)
- Provide **individual patient counselling** in the local language, covering:
  - Nature of T2DM and importance of regular medication
  - Role of each prescribed medicine
  - Correct timing in relation to meals
  - What to do if a dose is missed
  - Possible side effects and when to report them
- Provide **written and visual aids**, including:
  - A personalised medication schedule (timing chart)
  - A simple information leaflet on diet, exercise, foot care, and self-monitoring of blood glucose (if applicable)

At **follow-up visits (3 and 6 months)**:

- Medication adherence will be reassessed using MMAS-8.
- Clinical and laboratory parameters will be recorded (HbA1c at 6 months, FBS/PPBS if available at 3 and 6 months).
- The pharmacist will:
  - Reinforce key educational messages
  - Review any new prescriptions
  - Address new or ongoing adherence barriers
  - Document and communicate any drug-related problems to the physician

In addition, **telephonic follow-up** will be conducted at least once a month to remind patients about medication schedules, follow-up visits, and to answer simple queries related to drug use and lifestyle measures.

**3.8 Outcome Measures**

**Primary outcomes**

- Change in mean MMAS-8 score between baseline and 3 months, and between baseline and 6 months
- Change in mean HbA1c (%) between baseline and 6 months

**Secondary outcomes**

- Changes in fasting and post-prandial blood sugar at 6 months
- Changes in blood pressure and, where available, lipid profile
- Number and types of drug-related problems identified and resolved
- Frequency of self-reported hypoglycaemia episodes

- Change in diabetes-related knowledge scores from baseline to 6 months

**3.9 Statistical Analysis**

Data will be entered into Microsoft Excel and analysed using SPSS, R, or equivalent software.

- Descriptive statistics will be used to summarise demographic and clinical data (mean, standard deviation, median, interquartile range, frequencies, and percentages as appropriate).
- The normality of continuous variables will be checked using appropriate tests (e.g. Shapiro–Wilk).
- For normally distributed variables, paired t-tests will be used to compare baseline and follow-up values (e.g. HbA1c, MMAS-8 score). For non-normal data, the Wilcoxon signed-rank test will be applied.
- Categorical variables (e.g. proportion of patients with high, medium, and low adherence) will be compared using Chi-square tests or Fisher's exact test as required.
- A p-value $< 0.05$ will be considered statistically significant.

## 4. (Hypothetical) Results – Linked to Your Tables

When you have real data, you'll replace these numbers—but this is how you'd *write it up*.

**4.1 Baseline Characteristics**

A total of 120 patients were enrolled. Of these, 100 completed the 6-month follow-up and were included in the final analysis; 20 patients were lost to follow-up or had incomplete data.

The mean age of the analysed cohort was 55.2 ± 9.8 years, and 54% were male. The median duration of T2DM was 8 (interquartile range: 4–12) years. Hypertension and dyslipidaemia were the most common comorbidities. Approximately one-third of the patients were using insulin, either alone or in combination with oral hypoglycaemic agents, while the remainder were on oral drugs only. The mean baseline HbA1c was 8.9 ± 1.4%. Baseline demographic and clinical characteristics are summarised in Table 1.

**4.2 Changes in Medication Adherence and Glycaemic Control**

At baseline, the mean MMAS-8 score was 5.2 ± 1.4, reflecting generally low to medium adherence. Following the clinical pharmacist-led intervention, the mean MMAS-8 score increased to 6.6 ± 1.2 at 3 months and 7.1 ± 1.0 at 6 months. The improvement from baseline to 6 months was statistically significant ($p < 0.001$).

The mean HbA1c decreased from 8.9 ± 1.4% at baseline to 8.1 ± 1.2% at 6 months ($p = 0.002$). Fasting and post-prandial blood glucose levels also showed statistically significant reductions over the 6-month period. These results are presented in Table 2.

**4.3 Drug-Related Problems and Pharmacist Interventions**

Several categories of drug-related problems were identified by the clinical pharmacists during prescription review and patient interviews. Common issues included potential drug–drug interactions, inappropriate dosing, therapeutic duplication, non-adherence due to cost or misunderstanding, and incorrect timing of medication with respect to meals. For each identified problem, the pharmacist suggested interventions such as dose adjustment, switching to more affordable generic formulations, stopping unnecessary drugs, counselling about correct timing, and reporting suspected adverse drug reactions. An overview of drug-related problems and pharmacist actions is shown in Table 3.

## 5. Discussion

This prospective interventional study explored the impact of a clinical pharmacist-led intervention on medication adherence and glycaemic control in patients with type 2 diabetes mellitus in a tertiary care teaching

hospital in India. The main findings suggest that structured involvement of clinical pharmacists can meaningfully improve both adherence scores and HbA1c levels over a 6-month period.

At baseline, patients demonstrated suboptimal adherence, as reflected by the mean MMAS-8 score. This is consistent with other Indian and international studies showing that non-adherence to anti-diabetic medications is common and contributes to poor glycaemic control. Factors such as complex treatment regimens, lack of understanding about the disease, and financial constraints are frequently implicated. In our study, the pharmacist-led intervention targeted many of these modifiable factors through individual counselling, written schedules, and regular follow-up.

The observed improvement in adherence scores over time suggests that patients were more consistent with their medication use after receiving the intervention. This is in line with earlier studies demonstrating that regular, tailored education and follow-up by pharmacists can significantly enhance adherence in chronic diseases. The use of a validated tool like MMAS-8 also provides a structured way to quantify adherence and track change, which is useful both clinically and for research.

The reduction in HbA1c, though modest (for example, a drop of around 0.8 percentage points in the hypothetical data), is clinically important. Even a 0.5–1.0% absolute reduction in HbA1c has been shown in large trials to reduce the risk of microvascular complications. Importantly, this improvement was achieved without introducing new medications or advanced technologies; instead, it was primarily driven by optimising use of existing therapy via better adherence and closer monitoring. This is particularly relevant in low- and middle-income countries like India, where cost constraints limit access to newer agents for many patients.

An additional strength of this study is the focus on drug-related problems. Clinical pharmacists systematically reviewed prescriptions and identified issues such as potential interactions, inappropriate doses, therapeutic duplication, and unreported adverse reactions. Addressing these problems improves not only efficacy but also safety and cost-effectiveness of therapy. Collaboration between pharmacists and physicians is crucial in this process, and our study demonstrates that such collaboration is feasible in a busy tertiary care setting.

The findings also have broader implications for health system organisation. In many Indian hospitals, pharmacists are not yet fully integrated into patient care teams, and their role is often limited to dispensing. This study supports the idea that expanding clinical pharmacist responsibilities to include patient education, medication review, and ongoing follow-up can add substantial value—especially in diseases like diabetes that require long-term, complex management. Training programmes for Pharm.D and M.Pharm (Clinical Pharmacy/Pharmacy Practice) graduates can be structured to include such real-world interventions.

However, some challenges must be acknowledged. Implementing pharmacist-led interventions on a large scale requires adequate human resources, institutional support, and recognition of pharmacists as clinical professionals. Time constraints, patient literacy levels, and cultural factors may also influence the effectiveness of counselling and follow-up. Additionally, economic barriers, such as the cost of medicines or investigations, can persist even when adherence behaviour improves.

Overall, our results align with the growing body of evidence that multidisciplinary care, including clinical pharmacy services, improves outcomes in T2DM. Given the long-term nature of diabetes and the huge number of affected individuals in India, even modest improvements in control at the population level can translate into substantial reductions in complications and healthcare expenditure.

## 6. Limitations

This study has several limitations that should be considered when interpreting the findings:

1. **Single-centre design:** The study was conducted in one tertiary care teaching hospital, which may limit the generalisability of the results to other settings, such as primary health centres or private clinics.
2. **Single-arm pre–post design:** There was no control group without pharmacist intervention. Therefore, improvements in adherence and HbA1c could theoretically be influenced by other factors such as changes in physician practice or patient motivation over time.
3. **Reliance on self-reported adherence:** Although MMAS-8 is widely used and validated, it remains a self-reported measure and may be influenced by social desirability or recall bias. Objective measures like pill counts or refill records were not used.
4. **Short follow-up duration:** The follow-up period was six months, which may not capture the long-term sustainability of improved adherence and glycaemic control.
5. **Limited economic evaluation:** The study did not include a formal cost-effectiveness analysis, which would be useful to convince policymakers and administrators to invest in clinical pharmacy services.

Future research could address these limitations by including control groups, extending the follow-up period, incorporating objective adherence measures, and performing economic analyses.

## 7. Conclusion

This study highlights the important role that clinical pharmacists can play in the management of type 2 diabetes mellitus in a tertiary care teaching hospital setting in India. A structured intervention consisting of detailed counselling, written medication schedules, regular follow-up, and systematic identification of drug-related problems was associated with improved medication adherence and better glycaemic control over six months. Given the heavy burden of T2DM and the high prevalence of poor control in the Indian population, integrating clinical pharmacists into diabetes care teams represents a practical and potentially cost-effective strategy to improve outcomes. Policymakers, hospital administrators, and educators should consider expanding and formalising clinical pharmacy services, particularly in government teaching hospitals, and ensure that pharmacy curricula prepare graduates for active patient-centred roles.

Further multi-centre, controlled studies with longer follow-up and economic evaluations are warranted to strengthen the evidence base and guide national policies. Nonetheless, the findings of this study provide encouraging support for the inclusion of clinical pharmacists as integral members of the multidisciplinary team caring for patients with type 2 diabetes mellitus.